ADAPTABILITY OF THE PANCREAS TO THE QUALITY OF THE FOOD DURING EXPOSURE TO HIGH TEMPERATURE AND INSOLATION

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The normal function of the digestive organs is known to include a process of delicate adaptation to the quality of the food [1, 10, 12-14]. The adaptability of the digestive glands to the nature of the food consists not only of an increase or decrease in the quantity of enzymes secreted by them, but also of a change in the activity of each individual enzyme in relation to animal or vegetable products, depending on the quality of the food consumed [7]. These findings are of great importance for the solution of many of the problems associated with the organization of rational feeding in circumstances when the organism is exposed to unfavorable environmental factors, including high temperatures and insolation.

Under the influence of high temperatures and insolation, profound changes take place in the secretory and the motor-evacuatory activity of the gastro-intestinal tract [11]. Under these circumstances, the volume of pancreatic juice secreted and the activity of certain of its enzymes are greatly reduced, and the dynamics of the secretion process are disturbed [5, 6, 9]. It might be assumed that these changes may also influence the adaptability of the pancreas to the quality of the food. The present investigation was carried out in order to test this hypothesis.

METHOD

The blood amylase activity of six adult dogs was compared at the optimal temperature and during exposure of the animals to a high temperature and insolation. During the time of the experiments the animals were kept on a mixed diet. The experiments began 16-18 h after the last meal. The first blood sample was taken before feeding; the animal then received 200 g bread or 150 g meat, and further samples were taken 1, 2, and 4 h after the dogs had taken the food stimulus. The experiments were carried out in summer, in the hottest time of the year, when the air temperature was not below 33° and not above 40°. After the first blood sample had been taken, the unfed animals were put outside in the sun and fed. The animals remained there for 2 h, and during this time two blood samples were taken from them. The dogs were then transferred to the shade, where the experiment continued for a further 2 h.

The index of the adaptability of the pancreas to the quality of the food was the change in the blood amylase activity against substrates of animal (glycogen) and plant (starch) origin, depending on whether the dog had received bread or meat. The amylase activity in relation to the different substrates was determined by means of a type FÉK-M photoelectric colorimeter, using the Smith–Roy method as modified by A. M. Ugolev [8]. The amylase activity was expressed as a percentage of the substrate hydrolyzed.

When describing the relative amylase activity against the various substrates, the author used the terms introduced by A. M. Ugolev, which have been generally adopted. The activity of the enzyme against substrates of vegetable origin was called phytolytic, and against substrates of animal origin–zoolytic.

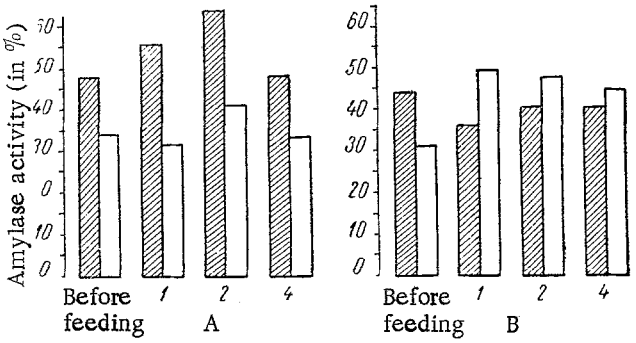

Fig. 1. Phytolytic (shaded columns) and zoolytic (unshaded columns) activity of blood amylase of dog No. 1 after eating bread (A) and meat (B) under moderate temperature conditions (mean data of 6 experiments). Here and in Fig. 2 the numbers below the columns denote the time after feeding (in hours).

TABLE 1. Ratio between Phytolytic and Zoolytic Activity of Blood Amylase of Dogs Receiving Different Types of Food at Moderate Temperature Conditions (M± m). Mean Data of Not Less Than 6 Experiments

Dog no.	Time after feeding (in hours)					
	1	2	4	1	2	4
	Fed with bread			Fed with meat		
1	1,83±0,18	1,64±0,10	1,64±0,15	0,72±0,04	0,84±0,03	0,89±0,10
2	1,72±0,14	1,99±0,26	1,78±0,25	0,74±0,11	0,68±0,10	0,90±0,14
3	1,65±0,20	2,05±0,42	2,01±0,50	0,77±0,02	0,89±0,02	1,04±0,06
4	1,66±0,23	1,33±0,12	1,43±0,10	0,91±0,22	0,83±0,27	0,93±0,14
5	1,72±0,11	1,72±0,20	1,45±0,12	1,13±0,25	1,11±0,20	0,96±0,12
6	1,24±0,18	1,33±0,14	—	0,82±0,07	0,86±0,02	—

RESULTS

In control experiments (without exposure to a high temperature), when the dogs ate bread the phytolytic activity of the blood amylase was higher than its zoolytic activity, but when they ate meat, on the contrary, the zoolytic activity was higher than the phytolytic (Fig. 1). Accordingly, in the first case the ratio of phytolytic activity to zoolytic was more than unity, while in the second case it was less than unity (Table 1).

In the experiments in which the dogs were exposed to sunlight, different results were obtained: the spectrum of amylase activity did not always correspond to the quality of the food (Fig. 2). If the dogs ate bread the level of the zoolytic activity of the plasma remained almost unchanged by comparison with the initial level (fasting). The level of the phytolytic activity in these circumstances rose very slightly, and not until 1 h after eating, after which it fell again to the original level. Feeding with meat in these conditions did not produce an excess of zoolytic over phytolytic activity, as was observed in the control experiments in the shade, when on the contrary, while the zoolytic activity remained unchanged the phytolytic activity as a rule was increased. The latter continued at a high level for the first 2 h after eating meat (while the animal was exposed to sunlight), and it fell to the initial level at the end of the fourth hour (2 h after the action of a high temperature and insolation).

Hence, in the conditions of a high temperature and insolation the phytolytic activity of the amylase in most cases was higher than the zoolytic activity, regardless of the quality of the food eaten (Table 2).

The blood amylase is an enzyme of pancreatic origin, and its level and properties reflect with a fair degree of accuracy the state of the pancreas [2-4], 8]. It must, therefore, be considered that the regular change in the blood amylase activity against polysaccharides of vegetable and animal origin, depending on the properties of the food eaten, is evidence of the delicate adaptability of the pancreas to the quality of the food products. These conclusions are in agreement with the facts established with respect to the pancreas [10].

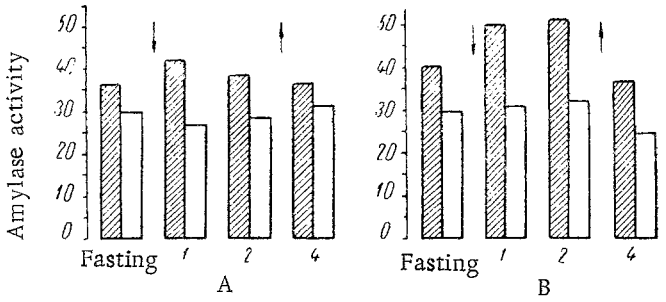

Fig. 2. Phytolytic (shaded columns) and zoolytic (unshaded columns) activity of blood amylase of dog No. 1 after eating bread (A) and meat (B) in conditions of exposure to a high temperature and insolation (mean data of six experiments). The arrows indicate the beginning and end of the animals stay in the sunlight.

TABLE 2. Ratio between Phytolytic and Zoolytic Activity of Blood Amylase of Dogs Exposed to High Temperature and Insolation (M± m). Mean Data of Not Less Than 6 Experiments

Dog no.	Time after feeding (in hours)					
	1	2	3-4	1	2	4
	fed with bread			fed with meat		
	in sunlight		in shade after exposure to light	in sunlight		in shade after exposure to light
1	1,67 ± 0,17	1,45 ± 0,17	1,34 ± 0,25	1,8 ± 0,29	1,94 ± 0,36	1,84 ± 0,61
2	1,57 ± 0,38	1,32 ± 0,18	1,08 ± 0,23	1,17 ± 0,18	1,79 ± 0,17	1,98 ± 0,40
3	1,44 ± 0,13	1,56 ± 0,14	1,23 ± 0,17	1,91 ± 0,17	1,68 ± 0,18	2,06 ± 0,28
4	1,93 ± 0,70	1,68 ± 0,46	1,77 ± 0,36	1,18 ± 0,03	1,35 ± 0,16	1,36 ± 0,20
5	1,67 ± 0,21	1,35 ± 0,24	1,07 ± 0,20	1,64 ± 0,43	1,39 ± 0,14	1,25 ± 0,15

The fact that the spectrum of the blood amylase activity did not correspond to the quality of the food consumed, which was observed during exposure to a high temperature and insolation, probably indicates that under the action of these environmental factors profound changes take place in the functional state of the pancreas. It may be postulated that these changes have a definite influence on the intensity of individual stages of synthesis responsible for the phytolytic or zoolytic activity of the amylase.

It is important to remember that in the conditions of exposure to a high temperature and insolation, the blood amylase is better able to hydrolyze the product of vegetable origin (starch) than the product of animal origin (glycogen). Similar findings with respect to gastric pepsin were obtained in the experiments of A. Yu. Yunusov and G. F. Korot'ko [11].

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
